Characterization of P3HT-FWCNT thin film for photovoltaic solar cell application

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1.Abstract

The global share of photovoltaic (PV) technologies in the electricity and energy production still remain marginal today and is likely to remain this way for a long period of time especially in the poor developing countries [1]. The evidence of the limited global impact of PV is marked by the increasing market share of fossil fuels in the generation of electricity [2]. Carbon nanotubes (CNT) have emerged as one of the leading additives for improving the thermoelectric properties of organic materials due to their unique structure and excellent electronic transport properties [3]. In this study poly(3 – hexylthiophene) and few-walled carbon nanotubes (P3HT-FWCNT) at different ratios were investigated for the purpose of improving P3HT absorption and conductivity for applications in organic solar cells.

The films were characterized using the X-ray diffraction (XRD), ultra violet to visible (UV-Vis) spectrophotometer, photoluminescence (PL) intensity, field emission scanning electron microscopy (FESEM), energy-dispersive spectroscopy (EDS), Fourier Transform Infrared Spectroscopy (FTIR) and current-voltage (I-V) characterization.

2.Experimental

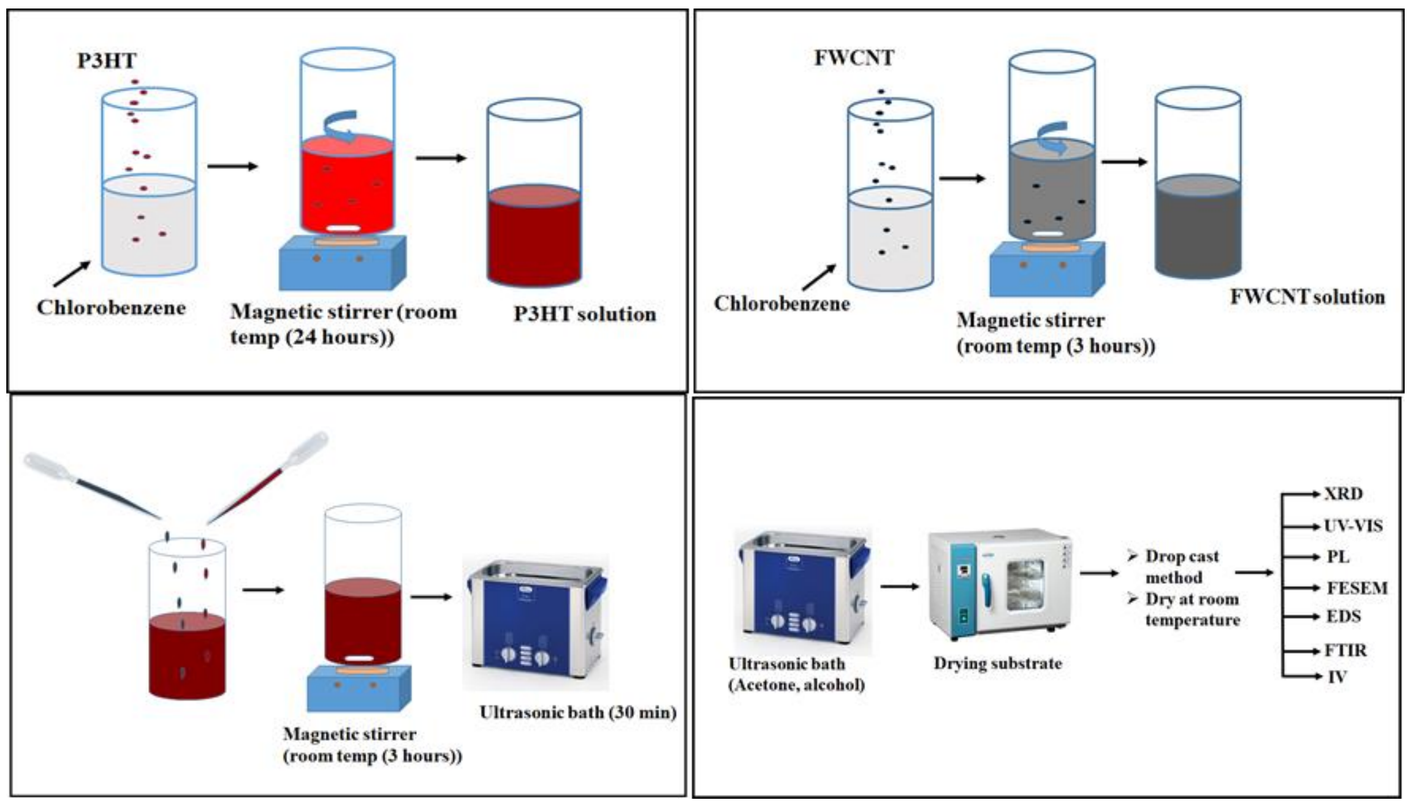

Fig. 1: Schematic diagram of P3HT-FWCNT preparation process

3.Results

❑ XRD Analysis

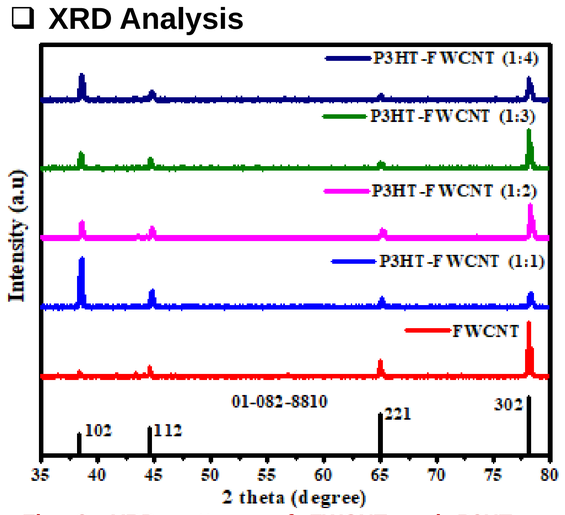

Fig. 2: XRD patterns of FWCNT and P3HT-FWCNT at different ratios.

❑ Optical properties

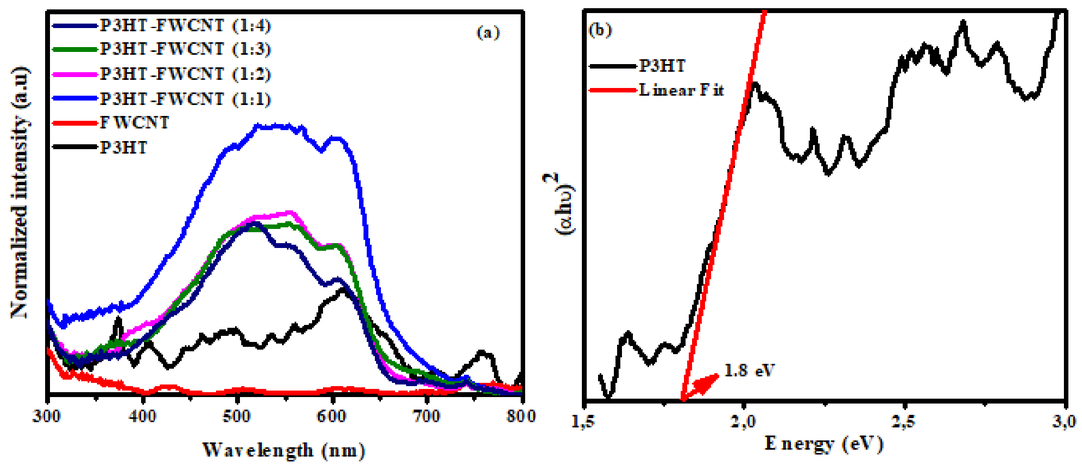

Fig.3: (a) P3HT, FWCNT and P3HT-FWCNT at different ratios (b) Tau'C plot of P3HT

SAMPLE NAME	BANDGAP (eV)
FWCNT	2.7
P3HT	1.8
P3HT-FWCNT (1:1)	1.8
P3HT-FWCNT (1:2)	1.9
P3HT-FWCNT (1:3)	1.9
P3HT-FWCNT (1:4)	1.9

Table 1: Bandgap of prepared films

❑ Photoluminescence (PL) properties

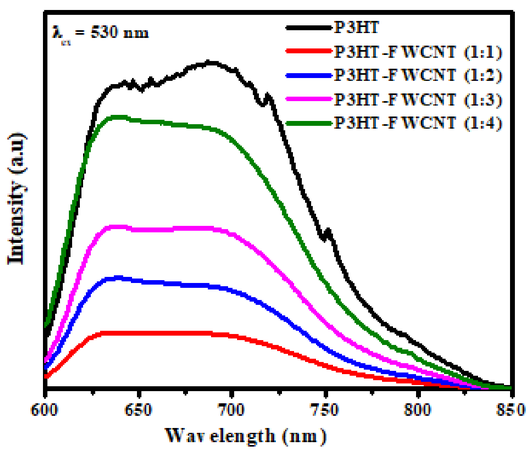

Fig.4: PL spectra od P3HT and P3HT-FWCNT at different ratios

❑ FESEM and EDS Analysis

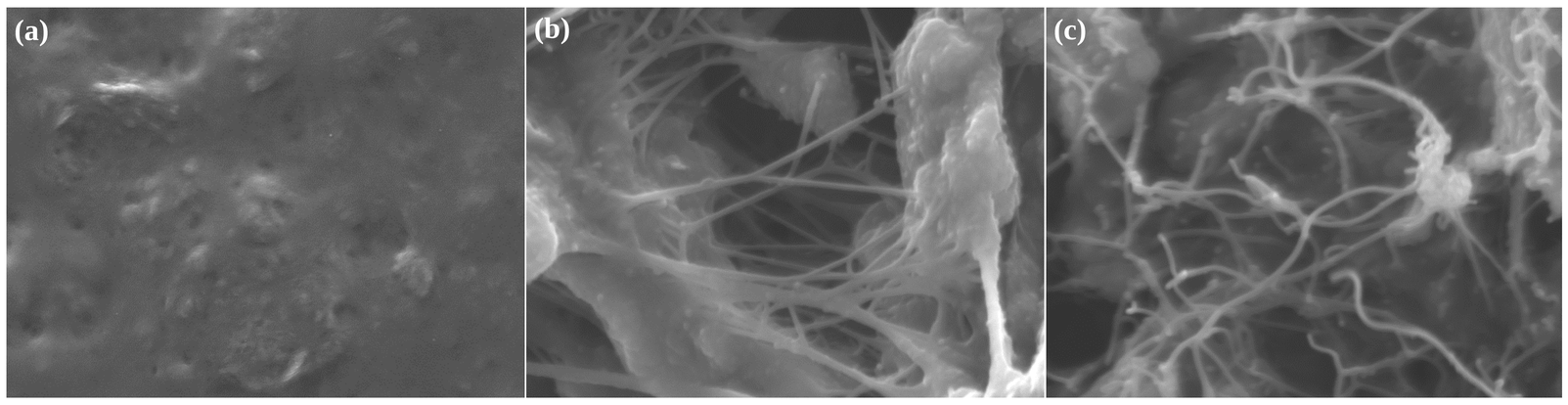

Fig.5: FESEM images (a) P3HT (b) FWCNT (c) P3HT-FWCNT (1:1)

❑ EDS

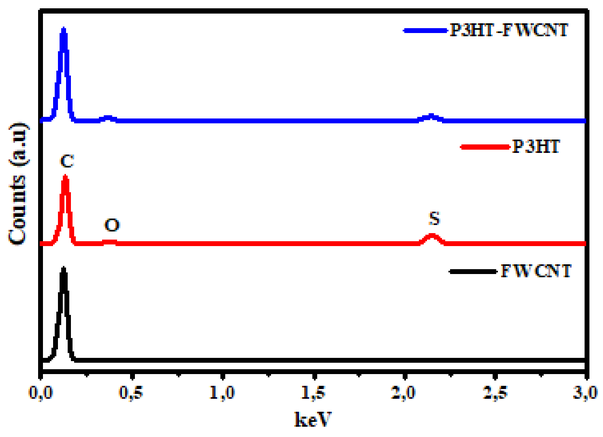

Fig.6: EDS spectra of FWCNT, P3HT and P3HT-FWCNT (1:1)

❑ FTIR

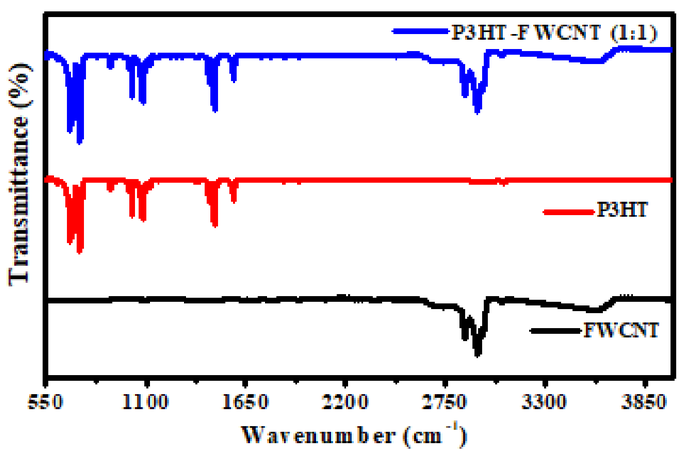

Fig.7: FTIR spectra of FWCNT, P3HT and P3HT-FWCNT (1:1)

❑ I-V Characterization

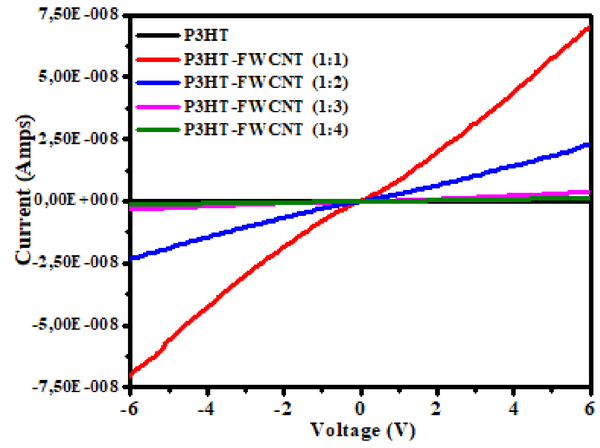

Fig.8: I-V characteristic spectra of P3HT and P3HT-FWCNT at different ratios

4. Conclusion

- XRD results revealed that all samples have a cubic structure.
- UV-Vis showed that P3HT-FWCNT (1:1) have the highest absorption and it also quenches the P3HT intensity even more in PL, reducing the electron-hole recombination.
- The disordered structured of FWCNT was observed from the FESEM.
- EDS confirmed the incorporation of P3HT in FWCNT.
- FTIR confirmed the P3HT and FWCNT vibration modes and I-V characterization showed an improvement in conductivity.

5. Reference

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